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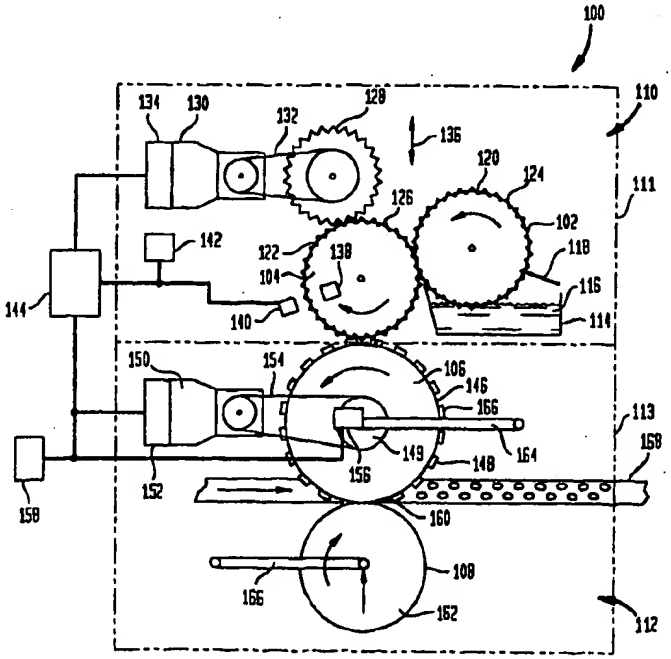
(54) Title: APPARATUS AND METHOD FOR EMBOSSING AND VALLEY PRINTING ELONGATED SUBSTRATES

(57) Abstract

An apparatus and method for embossing and valley printing elongated substrates is in the nature of a three roll angle offset gravure printing system which incorporates embossing. The apparatus provides independent control (134, 152) of the surface speed of the transfer roll (122) for transferring an ink layer to the exposed raised portions of the printing and embossing roll (166). By maintaining substantial identical surface speed between the transfer roll (122) and the printing and embossing roll (166), ink is transferred without smearing or smudging at the appropriate thickness to provide valley printing in various substrates such as louvers and the like.



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APPARATUS AND METHOD FOR EMBOSSING AND VALLEY PRINTING ELONGATED SUBSTRATES

TECHNICAL FIELD

The present invention relates in general to the art of embossing and printing, and more particularly, to an apparatus and method for simultaneously embossing and valley printing elongated substrates such as polymer louvers and the like.

BACKGROUND ART

Elongated louvers such as vertically and horizontally oriented slates of the type used in window treatment assemblies are well known in the art and commercially available in a wide variety of designs. The formation of louvers usually occurs through a forming machine, such as but not limited to, an extruder which produces an elongated continuous louver from a hot melt thermoplastic material such as polyvinyl chloride (PVC) and the like.

The window treatment industry has recognized the desirability of forming a decorative pattern on at least one exposed surface of the louver. By providing various decorative patterns, various effects can be obtained so as to provide a wide variety of products which will appeal to the consumer, as well as satisfying various decorating goals. It has been known to form decorative patterns in a louver by embossing a desired pattern or other like indication in at least one exposed surface of the louver through the utilization of cooperative pairs of rollers engaging opposite surfaces of the louver. For example, Kierson, U.S. Patent No. 5,311,814 discloses an assembly for forming or embossing a decorative pattern on at least one exposed surface of an elongated slat preferably of the type used in vertical blinds. The assembly includes a pair of driven rollers which are designed, dimensioned and configured to engage opposite sides of a slat immediately subsequent to its formation by a

plastic extruder. The exterior surface of one of the rollers has a decorative pattern formed thereon, and when forced into confronting engagement with an exposed surface of the slat, the decorative pattern is transferred by an embossing technique. A similar embossing process for laminated plastic panels is disclosed in Wellen, U.S. Patent No. 3,481,818.

In order to enhance the decorative appearance of the embossed louver, it is desirable to impart color to the louver. In particular, it has been desired to provide color in a predetermined pattern typically within the valley formed during the embossing process. One approach is disclosed in Lewicki, Jr., U.S. Patent No. 3,887,678 by preprinting the substrate to be embossed with various colored ink in a predetermined pattern using conventional rotogravure printing processes. This process has rendered it extremely difficult, if not impossible, to provide alignment of the pattern on the embossing roll with the printed pattern on the substrate to be embossed. Hence, a mismatch between the two patterns is often noted which detracts from the appearance of the resulting product. Ruppel, et al., U.S. Patent No. 5,339,730 discloses a method for printing and embossing sheets of paper made of cellulose wadding and with two or more plies. The method discloses applying ink to one of the sheets as it travels around a first embossing roller prior to being bonded with a second sheet which passes around another embossing roller. The resulting printed pattern is sandwiched between the two sheets which are glued together.

Terwilliger, U.S. Patent No. 4,112,189 discloses a process for multicolor valley printing and embossing of flooring material. The apparatus includes a rotatable embossing and printing roll having an engraved surface contour representing a decorative pattern to be embossed and printed on a sheet of flooring material. A plurality of rotatable pattern

rolls are arranged in operative engagement with the surface of the embossing and printing roll. Each pattern roll is designed to receive a different color ink and to transfer the ink to a discrete surface area of the embossing and printing roll in a manner such that certain portions of the surface area thereof receive one color ink from a single pattern roll and other portions thereof receive overlapping layers of different color inks from at least two pattern rolls. The pattern rolls are formed with raised portions corresponding to predetermined discrete raised surface areas of the embossing and printing roll to which ink from such pattern roll is to be applied. From the foregoing, it can be appreciated that there is the requirement for maintaining proper alignment between the pattern rolls and the engraved surface of the printing and embossing roll. To accomplish this registration, the embossing and printing roll, the pattern rolls, as well as the inking rolls of the ink transfer system are all operatively linked together by a gear train which is driven by a motor.

The aforementioned single drive system as disclosed in Terwilliger suffers from a number of disadvantages. For example, it is important that the surface speed of the pattern roll be matched to the surface speed of the printing and embossing roll. Otherwise, an improper layer of ink will be transferred, either being too little or too much, which will adversely impact on the appearance of the resulting printed and embossed material. The disclosed single drive system provides no ability to adjust the individual surface speeds as may be required to accommodate variations in roll diameter, either initially or during the embossing process.

There is further disclosed in Snyder, U.S. Patent No. 3,850,095 an apparatus and method for embossing and valley printing of carpets with a hot melt ink. In the disclosed apparatus, hot melt ink is

transferred from a pickup roll immersed in the liquefied hot melt ink to a transfer roll. From the transfer roll, the hot melt ink is transferred to a inking roll which is in operative engagement with a printing and embossing roll. Snyder suffers from similar disadvantages noted with respect to Terwilliger in the inability to control the surface speed of the inking roll and printing and embossing roll.

Accordingly, there is an unsolved need for further improvements in an apparatus and method for embossing and valley printing elongated substrates.

DISCLOSURE OF THE INVENTION

An object of the present invention is to provide an apparatus and method for embossing and valley printing elongated substrates using a three roll angular offset gravure printing system.

Another object of the present invention is to provide an apparatus and method for embossing and valley printing elongated substrates wherein the surface speed of the rolls may be controlled independently to allow for the accurate inking of the printing and embossing roll with the proper amount of ink transfer.

Another object of the present invention is to provide an apparatus and method for embossing and valley printing elongated substrates wherein the printing is accurately aligned with the embossed areas of the substrate.

The present invention discloses and describes a three roll angular offset gravure printing system wherein the third roll is also an embossing roll. The embossing roll is backed up with a fourth roll for hydraulic embossing and printing on the substrate surface within the nip formed between the third or fourth rolls. The substrate is in the nature of an elongated louver which is formed from hot extruded PVC material. It is, however, to be understood that the present invention is suitable for embossing and valley

printing other substrates for other applications for use in decorative coatings and the like, as well as materials other than PVC.

The first roll in the apparatus of the present invention is a pickup roll which picks up ink from a supply thereof, such as an ink bath. The ink is doctored from the pickup roll surface, leaving a precise amount of ink for transfer to a second roll, which is a rubber coated transfer roll having an unpatterned surface. This is achieved without ink smearing by gearing the first and second rolls to a first drive motor. The transfer roll is also maintained at the same surface speed as the surface of the printing and embossing roll, i.e., the third roll, by providing the embossing roll with a separate drive motor that maintains the correct relative speed therebetween. The relative surface speed is measured by independent speed sensors with indicators which allow for controlling the speed either manually or by computer operation.

Ink from the transfer roll is transferred through kiss contact with the printing and embossing roll so that only the high points or raised areas on the top surface of the roll become inked. The passing of the hot extruded PVC louver or other material between the inked printing and embossing roller and backup roller under hydraulic pressure provides an embossed decorative pattern to the substrate with perfect ink color registration within the valleys of the embossed printed pattern.

In accordance with one embodiment of the present invention there is described a method for embossing and valley printing a pattern on a substrate comprising applying ink to the moving surface of a pickup roll; transferring the ink directly to an unpatterned moving surface of a transfer roll; transferring the ink from the surface of the transfer roll directly to raised portions on the moving surface

of an embossing roll, the raised portions defining a surface contour in the form of a pattern; and advancing a substrate against the moving surface of the embossing roll so that the side of the substrate in contact with the embossing roll is embossed and valley printed with the pattern.

In accordance with another embodiment of the present invention there is described a method for embossing and valley printing a pattern on a substrate comprising applying ink to the moving surface of a transfer roll; transferring the ink from an unpatterned surface of the transfer roll to raised portions on the moving surface of an embossing roll, the raised portions defining a surface contour in the form of a pattern; advancing a substrate against the moving surface of the embossing roll so that the side of the substrate in contact with the embossing roll is embossed and valley printed with the pattern; and independently driving the transfer roll surface and the embossing roll surface at substantially identical speeds while the ink is being transferred from the transfer roll to the embossing roll and while the embossing roll is embossing and valley printing the substrate.

In accordance with another embodiment of the present invention there is described an apparatus for embossing and valley printing a pattern on a substrate, the apparatus comprising a rotatable pickup roll having an unpatterned surface in communication with an ink supply; a rotatable transfer roll having a surface in operative arrangement with the surface of the pickup roll, the pickup roll transferring the ink therefrom to the unpatterned surface of the transfer roll; a rotatable embossing roll having raised surface portions defining a surface contour in the form of a pattern, the embossing roll being in operative arrangement with the transfer roll whereby the ink is transferred to the raised surface portions of the embossing roll; a first

motor drive rotating the transfer roll; and a second motor drive rotating the embossing roll independent of rotating the transfer roll by the first motor drive.

In accordance with another embodiment of the present invention there is described an apparatus for embossing and valley printing a pattern on a substrate, the apparatus comprising a rotatable pickup roll in communication with an ink supply; a rotatable transfer roll having an unpatterned surface in operative arrangement with the pickup roll, the pickup roll directly transferring the ink therefrom to the unpatterned surface of the transfer roll; and a rotatable embossing roll having raised surface portions defining a surface contour in the form of a pattern, the embossing roll being in operative arrangement with the unpatterned surface of the transfer roll whereby the ink is directly transferred to the raised portions of the embossing roll.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the present invention will be more fully and readily apparent from the detailed descriptions of the preferred embodiments set forth below, when taken in conjunction with the accompanying solo drawing, which is a diagrammatic illustration of the apparatus and method for embossing and valley printing elongated substrates in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In describing the preferred embodiments of the subject matter illustrated and to be described with respect to the drawing, specific terminology will be resorted to for the sake of clarity. However, the invention is not intended to be limited to the specific terms so selected, and is to be understood that each specific term includes all technical equivalence which operate in a similar manner to accomplish a similar purpose.

Referring now to the drawing, where like reference symbols represent like elements, there is shown an apparatus for embossing and valley printing elongated substrates which is generally designated by reference numeral 100. As previously noted, the present invention is intended to have its primary application for embossing and valley printing of elongated substrates such as louvers in the nature of slats utilized for decorative window treatments, for example, vertical and horizontal blinds. However, it is to be understood that the present invention may be applied to the embossing and valley printing of any substrate which may be embossed and valley printed, for example, continuous lengths of natural and synthetic materials for use as decorative coverings such as wall paper, furniture, housesiding and the like. In addition, although the louvers have been described as being constructed from PVC material, it is to be understood that any other polymer material, as well as natural materials which can be embossed and valley printed are suitable for use with the apparatus and method of the present invention. The apparatus and method of the present invention will now be described with respect to embossing and valley printing of elongated louvers formed of PVC material by way of illustration only.

The apparatus 100 of the present invention includes a pickup roll 102, a transfer roll 104, a printing and embossing roll 106, and a backup roll 108. The printing and embossing roll 106 will hereinafter be referred to only as embossing roll 106, similar terminology being used throughout the claims. The pickup roll 102 and transfer roll 104 are arranged in an inking assembly 110 generally defined within the dashed lines 111. The embossing roll 106 and backup roll 108 form an embossing and valley printing assembly 112 as defined within the dashed lines 113.

The inking assembly 110 further includes an ink bath 114 containing a supply of ink 116 and an oscillating doctor blade 118. The pickup roller 102 is journaled for rotation with a lower portion thereof immersed in the ink bath 114 for receiving ink 116. The pickup roller 102 is constructed to include tiny pores in its surface 120 which is made by a machining process to hold the ink. One such pickup roll 102 is made by Pamarco Inc. of Roselle, New Jersey sold under the mark Evenflow Roll. The surface 120 of the pickup roll 102 is in operative engagement with the leading edge of the doctor blade 118.

The transfer roll 104 is rotatably journaled adjacent the pickup roll 102 having its unpatterned surface 122 in contact with the surface 120 of the pickup roll. Attached generally at one end of pickup roll 102 is a gear 124. A similar gear 126 is attached generally at a corresponding end of the transfer roll 104 opposing gear 124. As shown, gears 124, 126 are arranged in meshed engagement such that by rotation of transfer roll 104, a corresponding rotation of the pickup roll 102 will occur at the identical surface speed. The pitch diameter of the gears 124, 126 are designed to prevent the gears from bottoming out with respect to each other. This enables the gears 124, 126 to be separated slightly from each other while maintaining their meshed engagement. This allows the transfer roll 104 to be incrementally moved closer to the pickup roll 102 as may be desired in the event of dimensional changes in the diameter of the transfer roll or pickup roll.

By way of example, the transfer roll 104 is covered by an uninterrupted layer of buna rubber, a manmade material, which is compatible with the ink 116. The rubber covering in one embodiment is approximately ½ inch thick having a hardness of about 70 durometer. One such transfer roll 104 is obtainable from Onyx Manufacturing of Oswego, Illinois. During operation of

the apparatus as to be described hereinafter, the surface 122 of the transfer roll 104 may become contaminated. In such event, the surface 122 can be top dressed by removing in the order of about 5-10 thousandths of an inch of the rubber covering using a suitable machine such as a lathe. By virtue of the separation between the gears 124, 126, the transfer roll 104 may be moved closer to the pickup roll 102 so as to maintain its operative engagement therewith to compensate for the reduced diameter of the transfer roll resulting from the top dressing process. Similarly, the transfer roll 104 may be moved away from the pickup roll 102 as may be required in the event the diameter of the transfer roll was to increase, such as when replacing the rubber covering when worn out or damaged.

The gear 126 of the transfer roll 104 is maintained in meshed engagement with a drive gear 128 which is operatively coupled with a variable speed AC follower motor drive 130 by means of a suitable linking assembly 132 such as a drive chain or drive belt. Operation of the motor drive 130 is controlled by a suitable controller 134, both of which are well known in the art. The inking assembly 110 may be supported by a frame (not shown) which allows for vertical movement of the inking assembly as generally designated by arrow 136.

The surface speed of the transfer roll 104 can be determined by any suitable speed sensing and indicating device as well known in the art. For example, the surface speed can be monitored by placing a plastic disk 138 containing a metal slag on one end of the transfer roll. A proximity switch 140 senses each time the disk 138 containing the metal slag passes the proximity switch. This will provide a readout of the surface speed of the transfer roll 104 of a given diameter which may be displayed on a display 142 or the resulting signal can be sent to a microprocessor based

computer 144. It is to be understood that any other apparatus for determining the surface speed of the transfer roll 104 may be used. For example, an encoder device, i.e., an electronic speed indicator, which is available from Powermation Corp. of St. Paul, Minnesota may be used. As the ink assembly 110, as noted hereinabove, may require disassembly for top dressing the transfer roll 104, it is desirable that the speed indicating device not require attachment to the transfer roll or its shaft. Accordingly, it is preferred to use a proximity switch which does not require any attachment to the transfer roll as is generally required by using an encoder device.

The embossing and valley printing assembly 112 includes the embossing roll 106 and backup roll 108. The embossing roll 106 is a standard embossing roll of metal construction which is well known for use in the art of embossing polymer substrates. The surface 146 of the embossing roll 106 is patterned with a predetermined pattern of raised portions 148. The pattern to be embossed may be formed in the surface 146 of the embossing roll 106 using a variety of manufacturing techniques, such as by chemical etching, milling or routing such as disclosed in Morrison, et al., U.S. Patent No. 5,771,796.

The embossing roll 106 is coupled to a driver sprocket 149 at one end thereof for rotation by a variable speed AC lead drive motor 150 having a suitable controller 152. The drive motor 150 is operatively coupled to the sprocket 149 by means of a linking assembly 154 such as a drive chain or drive belt. In general, the drive motors 130, 150 and controllers 134, 150 are of the same design and construction.

The surface speed of the embossing roll 106 may be determined by using an encoder device 156 as previously described which is operatively coupled to the shaft (not shown) about which the embossing roll is

journaled. The encoder device will provide an output signal of the surface speed of the embossing roll 106 of given diameter which is displayed by either a display 158 or sent to the computer 144. It is contemplated that the displays 142, 158 may be combined into a single display if so desired having, for example, dual readouts.

The backup roll 108 is rotatably journaled opposing the embossing roll 106 so as to define a nip 160 therebetween. The surface 162 of the backup roll 108 is preferably coated with a rubber coating such as Hyalon rubber, which is a manmade coating having about an 80 durometer hardness. The backup roll 108 can be obtained from American Roll of Union Grove, Wisconsin. As the material to be embossed and valley printed is generally in the nature of a hot extruded PVC material, the embossing roll 106 and backup roll 108 are generally water cooled by supplying water thereto through supply pipes 164, 166, respectively.

The apparatus 100 having now been described, in particular the inking assembly 110 and embossing and valley printing assembly 112, the method of the present invention for embossing and valley printing elongated substrates will now be described. One throughput speed for the apparatus 100 for embossing and valley printing a louver 168 is about 30-50 feet per minute of linear louver speed. Depending upon the desired throughput, the embossing roll 106 is driven at a predetermined set speed by means of the lead drive motor 150 via controller 152. The embossing roll surface speed is determined by means of the encoder device 156 which is sent to either the display 158 or computer 144. The rotational speed of the embossing roll 106 is set by manual operation of the controller 152 or under programmed control of the computer 144.

Initially, the inking assembly 110 is raised such that the transfer roll 104 is out of operative engagement with the embossing roll 106. The transfer

roll 104 is rotated by operation of the follower drive motor 130 which is controlled by controller 134. The transfer roll surface speed is determined by the proximity switch 140. The transfer roll surface speed is adjusted to match the surface speed of the embossing roll 106 either manually using the controller 134 upon readout from the display 142 or under programmed operation of the computer 144. Subsequently, the inking assembly 110 is lowered such that the transfer roll 104 is engaged by the surface 146 of the embossing roll 106. The respective surface speeds of the transfer roll 104 and embossing roll 106 are monitored continuously by the proximity switch 140 and encoder 156. In the event of any difference between the speeds, the operator will adjust controller 134 to effect a change in the rotational speed of the transfer roll 104. In the alternative, the computer 144 will automatically sense the discrepancy in surface speeds and input a signal to the controller 134. It is also contemplated that the rotational speed of the embossing roll 106 may also be controlled in a similar manner so as to maintain the surface speeds of the embossing roll 106 and transfer roll 104 to be substantially the same, and preferably, identical.

In order to obtain an even transfer of ink 116 from the unpatterned surface 122 of the transfer roll 104 to the exposed surface of the raised portions 148 of the embossing roll 106, it is required that the surface speed between the two rolls be equal. For example, a uniform ink coating in the range of between 0.5-1 ml. is preferred. In the event that the surface speed of the embossing roll 106 is greater than the surface speed of the transfer roll 104, the thickness of the transferred ink coating may be too thin, as well as causing a smudging effect. On the other hand, if the surface speed of the embossing roll 106 is less than the surface speed of the transfer roll 104, too much ink 116 may be applied to the raised portions 148

resulting in printing of other than the valleys which would provide an unattractive appearance to the resulting louver 168. Accordingly, it can be appreciated that the apparatus 100 of the present invention allows for the maintaining of the surface speed of the transfer roll 104 to precisely match the surface speed of the embossing roll 106. This will result in the application of a predetermined thickness of ink 116 accurately in alignment to the raised portions 148 without any smearing or smudging of the ink.

From the foregoing description of the method of the present invention, ink 116 from the ink bath 114 is applied over the entire surface 120 of the pickup roll 102 by means of the doctor blade 118. The doctor blade 118 oscillates to prevent dirt particles from being trapped at the blade's edge which would otherwise affect the continuity of the ink being applied to the pickup roll 102. As the transfer roll 104 is coupled to the pickup roll 102 by means of meshed gears 124, 126, rotation of the transfer roll will also effect simultaneous rotation of the pickup roll. The pickup roll 102 transfers the ink layer to the unpatterned surface 122 of the transfer roll 104. The ink layer on the transfer roll 104 is applied to the exposed surface of the raised portions 148 on the embossing roll 106 by kiss contact therewith. Accordingly, only the exposed end areas of the raised portions 148 are coated with ink 116 for the subsequent embossing and valley printing to be accomplished by means of the embossing roll 106. The ability to maintain the transfer roll surface speed equal to the embossing roll surface speed is achieved by use of independent drive motors 130, 150 for independently controlling the rotational speed of the transfer roll 104 and embossing roll 106. The independent control may be achieved either manually via the individual controllers 134, 152 or automatically under the programmed control of the computer 144.

The embossing roll 106 and backup roll 108 are brought together to provide a pressure in the range of about 1500-2000 lbs. within the nip 160 which is applied to the face of the louver 168 over an area approximately 3½ inches long and ½ inch wide. The louver 168 is formed from hot extruded PVC material having an initial temperature of about 450-500°F which is fed to the nip 160 for embossing and valley printing by means of the embossing roll 106. By virtue of the embossing roll and backup roll 108 being water cooled, the output temperature of the louver 168 is generally in the range of about 250-300°F. The cooling of the louver 168 is generally preferred so as to set the embossing.

Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and application of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

INDUSTRIAL APPLICABILITY

The present invention can be applied in printing and embossing substrates.

CLAIMS:

1. A method for embossing and valley printing a pattern on a substrate comprising applying ink to the moving surface of a pickup roll; transferring said ink directly to an unpatterned moving surface of a transfer roll; transferring said ink from the surface of said transfer roll directly to raised portions on the moving surface of an embossing roll, said raised portions defining a surface contour in the form of a pattern; and advancing a substrate against the moving surface of said embossing roll so that the side of said substrate in contact with said embossing roll is embossed and valley printed with said pattern.

2. The method of claim 1, further including independently driving the transfer roll surface and the embossing roll surface at substantially identical speeds while said ink is being transferred from said transfer roll to said embossing roll.

3. The method of claim 2, wherein said transfer roll and said embossing roll are driven by independent variable speed motors.

4. The method of claim 1, further comprising providing said pickup roll with a first gear and said transfer roll with a second gear, and arranging said first and second gears in meshed arrangement whereby rotation of one of said rolls will cause rotation of the other of said rolls.

5. The method of claim 1, further comprising cooling said embossing roll.

6. The method of claim 1, further comprising arranging a backing roll opposing said embossing roll to define a nip therebetween, and advancing said substrate through said nip whereby said substrate is embossed and valley printed with said pattern.

7. The method of claim 6, further comprising cooling said backing roll.

8. The method of claim 1, further comprising providing a supply of said ink for application to said pickup roll.

9. The method of claim 1, wherein said substrate comprises a louver.

10. A method for embossing and valley printing a pattern on a substrate comprising applying ink to the moving surface of a transfer roll; transferring said ink from an unpatterned surface of said transfer roll to raised portions on the moving surface of an embossing roll, said raised portions defining a surface contour in the form of a pattern; advancing a substrate against the moving surface of said embossing roll so that the side of said substrate in contact with said embossing roll is embossed and valley printed with said pattern; and independently driving the transfer roll surface and the embossing roll surface at substantially identical speeds while said ink is being transferred from said transfer roll to said embossing roll and while said embossing roll is embossing and valley printing said substrate.

11. The method of claim 10, wherein said transfer roll and said embossing roll are driven by independent variable speed motors.

12. The method of claim 10, further comprising cooling said embossing roll.

13. The method of claim 10, further comprising arranging a backing roll opposing said embossing roll to define a nip therebetween, and advancing said substrate through said nip whereby said substrate is embossed and valley printed with said pattern.

14. The method of claim 13, further comprising cooling said backing roll.

15. The method of claim 10, further comprising providing a supply of said ink for application to said pickup roll.

16. The method of claim 10, further comprising setting the rotational speed of said embossing roll, determining the surface speed of said transfer roll and said embossing roll, and controlling the rotational speed of said transfer roll such that the surface speed of said transfer roll is substantially identical to the surface speed of said embossing roll.

17. The method of claim 10, wherein said substrate comprises a louver.

18. An apparatus for embossing and valley printing a pattern on a substrate, said apparatus comprising a rotatable pickup roll having an unpatterned surface in communication with an ink supply; a rotatable transfer roll having a surface in operative arrangement with the surface of said pickup roll, said pickup roll transferring said ink therefrom to said unpatterned surface of said transfer roll; a rotatable embossing roll having raised surface portions defining a surface contour in the form of a pattern, said embossing roll being in operative arrangement with said transfer roll whereby said ink is transferred to the raised surface portions of said embossing roll; a first motor drive rotating said transfer roll; and a second motor drive rotating said embossing roll independent of rotating said transfer roll by said first motor drive.

19. The apparatus of claim 18, further including a rotatable backing roll disposed adjacent to said embossing roll and defining a nip through which a substrate passes while contacting said embossing roll for being embossed and valley printed with said pattern.

20. The apparatus of claim 18, further comprising a first gear attached to said pickup roll and a second gear attached to said transfer roll, said first and second gears in meshed arrangement whereby

rotation of one of said rolls causes rotation of the other of said rolls.

21. The apparatus of claim 20, further comprising a third gear attached to said first motor drive, said third gear meshed with said second gear for rotation of said transfer roll by operation of said first motor drive.

22. The apparatus of claim 20, wherein said first and second gears are constructed to allow for increasing and decreasing the extent of their meshed engagement.

23. The apparatus of claim 18, further comprising a coolant source connected to said embossing roll for supplying a coolant thereto.

24. The apparatus of claim 18, further comprising a microprocessor operatively coupled to said first and second motor drives.

25. The apparatus of claim 18, further comprising an elongated substrate for passing through said nip while contacting said embossing roll.

26. The apparatus of claim 25, wherein said substrate comprises a louver.

27. The apparatus of claim 24, further comprising a coolant source connected to said backing roll for supplying a coolant thereto.

28. The apparatus of claim 18, further comprising a controller for said first and second motor drive for controlling the surface speed of said transfer roll and said embossing roll.

29. The apparatus of claim 28, wherein said controller comprises a first controller for said first motor drive and a second controller for said second motor drive, said apparatus further comprising a microprocessor adapted to receive information regarding the surface speeds of said transfer roll and said embossing roll and, based on the surface speed information providing instructions to at least said first controller to establish and maintain

substantially identical surface speeds for said transfer roll and said embossing roll.

30. An apparatus for embossing and valley printing a pattern on a substrate, said apparatus comprising a rotatable pickup roll in communication with an ink supply; a rotatable transfer roll having an unpatterned surface in operative arrangement with said pickup roll, said pickup roll directly transferring said ink therefrom to said unpatterned surface of said transfer roll; and a rotatable embossing roll having raised surface portions defining a surface contour in the form of a pattern, said embossing roll being in operative arrangement with said unpatterned surface of said transfer roll whereby said ink is directly transferred to the raised portions of said embossing roll.

31. The apparatus of claim 30, further comprising a rotatable backing roll disposed adjacent to said embossing roll and defining a nip through which a substrate passes while contacting said embossing roll.

32. The apparatus of claim 31, wherein said substrate comprises a louver.

33. The apparatus of claim 31, further comprising a coolant source connected to said backing roll for supplying a coolant thereto.

34. The apparatus of claim 30, further comprising a first gear attached to said pickup roll and a second gear attached to said transfer roll, said first and second gears in meshed arrangement whereby rotation of one of said rolls causes rotation of the other of said rolls.

35. The apparatus of claim 34, wherein said first and second gears are constructed to allow for increasing and decreasing the extent of their meshed engagement.

36. The apparatus of claim 30, further comprising a coolant source connected to said embossing roll for supplying a coolant thereto.

37. The apparatus of claim 30, further comprising a controller, said controller maintaining the surface speed of said transfer roll identical with the surface speed of said embossing roll.

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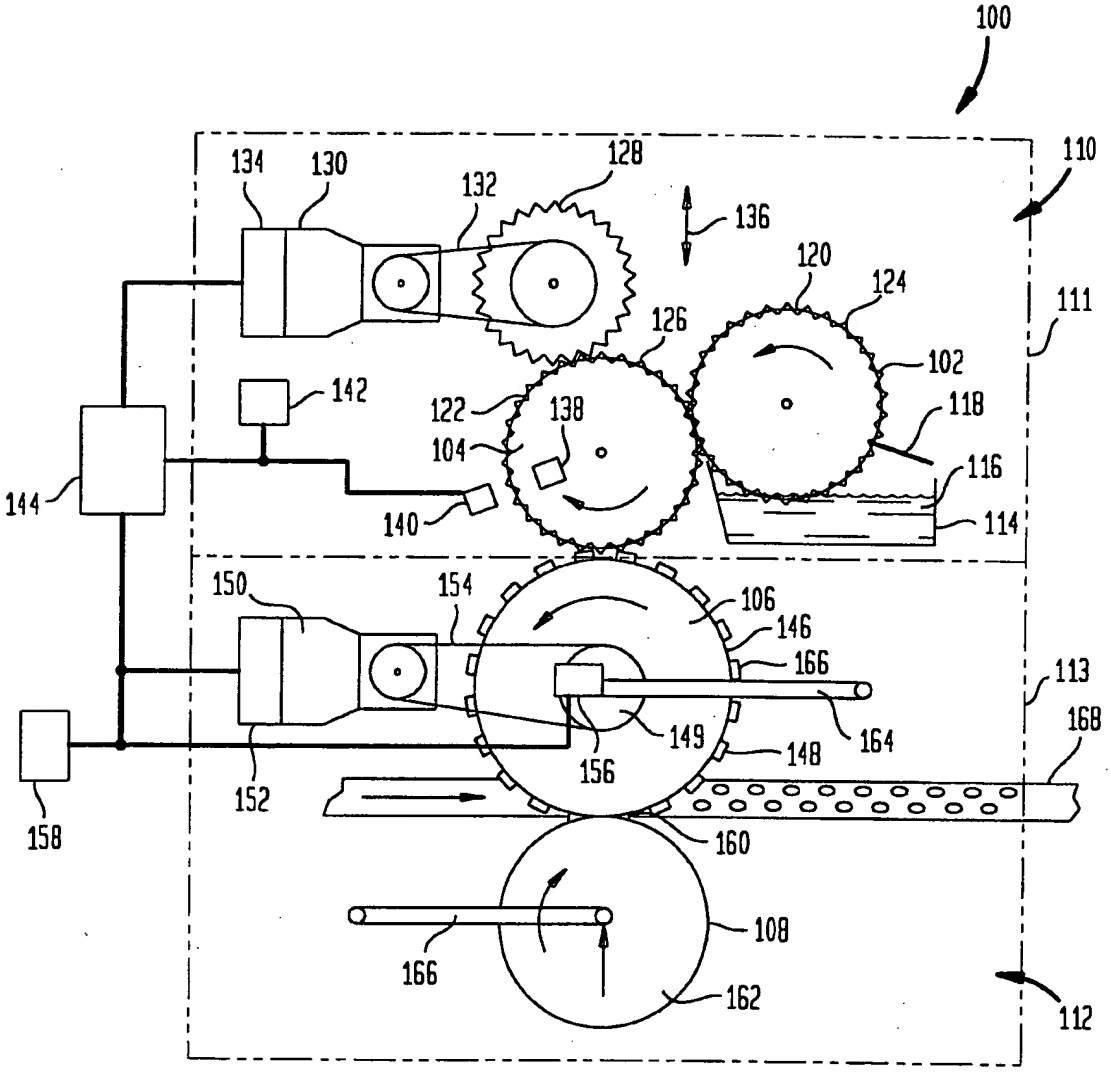
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/01979

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : B31F 1/07; B41F 5/04, 23/04; B41L 35/14
US CL :101/22, 23, 24, 32, 216, 217, 218, 219, 221, 487, 488
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 101/22, 23, 24, 32, 216, 217, 218, 219, 221, 487, 488

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS, STN (EUROPATFUL, JAPIO)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,837,275 A (MADSEN) 24 September 1974 (24.09.74) Fig. 1, col. 2 lines 32-46, col. 3 lines 10-35.	1, 4, 6, 8-10, 13, 15-17, 30-32, 34, and 35.
Y	US3,837,275 A (MADSEN) 24 September 1974 (24.09.74) Fig.1 col. 2 lines 32-46, col. 3 lines 10-35, col. 4 lines 19-23	2,3,5,7,11,12,14, 18-29,33,36,37
X	US 5,555,800 A (RICE) 17 September 1996 (17.09.96) Fig. 14, col. 10 lines 62-67.	1, 8, and 30.
X	EP 0 791 480 A2 (TSUDA) 27 August 1997 (27.08.97) Fig. 1, col. 4 lines 45-54.	1, 8, and 30.

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
22 MARCH 1999	15 APR 1999

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INTERNATIONAL SEARCH REPORT

International application No. —
PCT/US99/01979

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,477,783 A (HASHIMURA) 26 December 1995, Abstract, col 1, lines 33-61, col 4. lines 44-61, Fig. 2.	2,3,11,18- 29, 37
Y	US 3,893,795 A (NAUTA) 08 July 1975 (08. Figure 3, col. 5 lines 26-49.	5, 7, 12, 14, 23, 27, 33, and 36.